OCR
Oxford Cambridge and RSA

Level 3 Cambridge Technical in Engineering
05822/05823/05824/05825/05873

Unit 1: Mathematics for engineering

Monday 8 January 2018 – Afternoon
Time allowed: 1 hour 30 minutes

You must have:
- the formula booklet for Level 3 Cambridge Technical in Engineering (inserted)
- a ruler (cm/mm)
- a scientific calculator

First Name			Last Name					
Centre Number						Candidate Number				
Date of Birth	D	D	M	M	Y	Y	Y	Y		

INSTRUCTIONS
- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number, candidate number and date of birth.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- If additional answer space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **60**.
- The marks for each question are shown in brackets **[ ]**.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- An answer may receive no marks unless you show sufficient detail of the working to indicate that a correct method is being used.
- Final answers should be given to a degree of accuracy appropriate to the context.
- This document consists of **12** pages.

FOR EXAMINER USE ONLY	
Question No	**Mark**
1	/8
2	/9
3	/13
4	/10
5	/12
6	/8
Total	**/60**

Answer **all** the questions.

1 **(a)** Expand the brackets and simplify the expression $4x + 3(x - 2y)$.

.....

.....**[2]**

(b) Factorise the following.

(i) $2xy^2 + 4x^2y$

.....

.....**[2]**

(ii) $x^2 - 3x - 10$

.....

.....**[2]**

(c) Solve the equation.

$2x - 3 = 1 - x$

.....

.....

.....**[2]**

2 **(a)** **(i)** Convert $\frac{2\pi}{3}$ radians to degrees.

.....

.....**[1]**

(ii) Convert 270° to radians, giving your answer as a multiple of π.

.....

.....**[1]**

(b) The rule for placing a ladder against a wall is "bottom of ladder one unit out from the bottom of the wall, top of the ladder four units up the wall".
A ladder 6 m long is leant against a wall with its bottom 1.4 m away from the base of the wall on horizontal ground.

(i) Find how far up the wall the top of the ladder rests and explain whether the rule above is obeyed.

.....

.....

.....

.....

.....**[3]**

(ii) Find the angle that the ladder makes with the horizontal ground.

.....

.....**[2]**

(c) Calculate the area of a semicircular rug with diameter 3 metres.

.....

.....**[2]**

3 **(a)** Write as a single logarithm $\log a + 2\log b$.

.....

.....[2]

(b) A scientist started with 100 bacteria in a container. The growth of the bacteria can be modelled by the equation $N = 100e^{t/4}$ where N is the number of bacteria after t minutes.

(i) Calculate the number of bacteria present when $t = 5$.

.....

.....

.....[2]

(ii) After how many minutes does the number of bacteria exceed 1000?

.....

.....

.....[2]

(c) Solve the equation $x^2 + 3x - 5 = 0$. Give your answers correct to 3 decimal places.

.....

.....

.....

.....[3]

(d) Using the factor theorem or otherwise solve the equation $x^3 - 2x^2 - x + 2 = 0$.

.....

.....

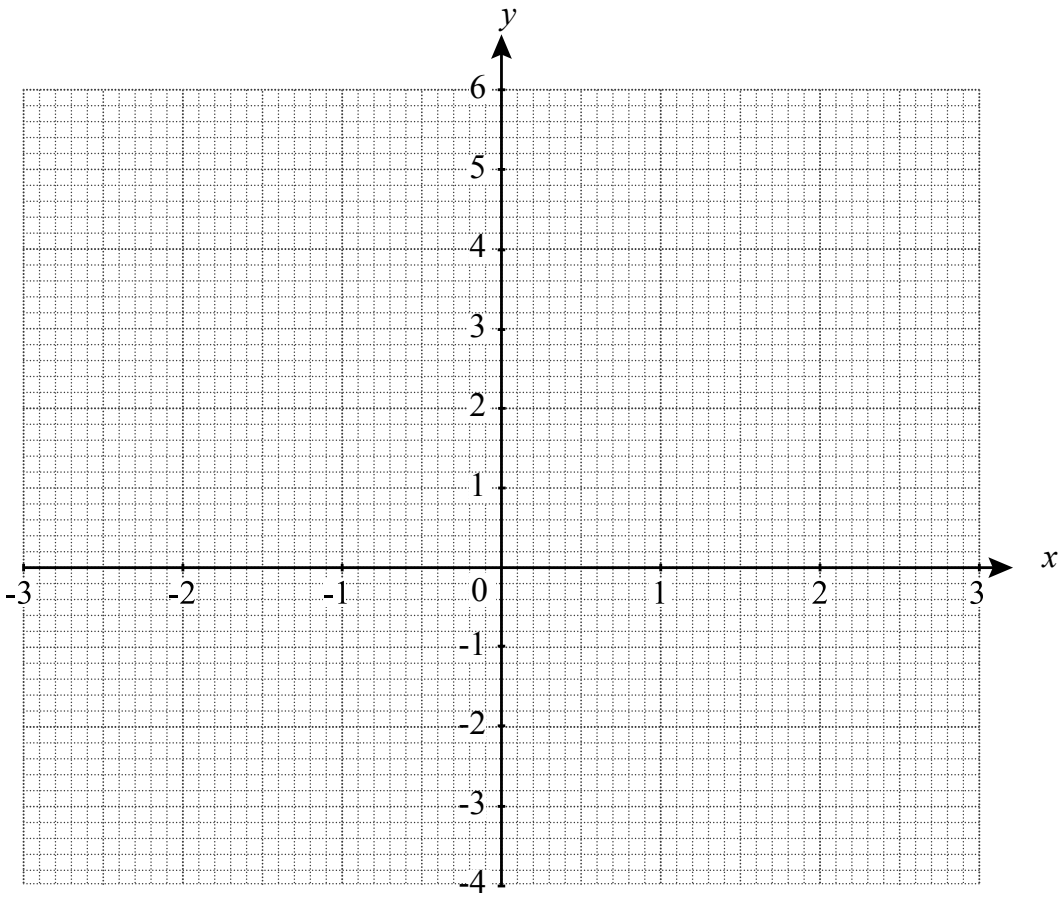
.....

.....

.....

.....[4]

4 **(a)** **(i)** On the grid below, plot the curve $y = x^3 - 3x + 1$ for $-2 \leqslant x \leqslant 2$.



[4]

(ii) Hence write down the three roots of the equation $x^3 - 3x + 1 = 0$ correct to 1 decimal place.

.....

.....**[2]**

(b) Find the equation of the line that passes through the point (4, 2) and is perpendicular to the line $2x + 5y = 7$.

.....

.....

.....

.....

.....

.....**[4]**

5 **(a)** Find the value of $\int_0^{\pi/4} \cos 2x \, dx$.

.....

.....

.....**[3]**

(b) A cylindrical tin has radius r cm and height h cm.

Its volume, V cm^3, is given by the formula $V = \pi r^2 h$.

Its surface area, S cm^2, is given by the formula $S = 2\pi r^2 + 2\pi rh$.

(i) Show that $S = 2\pi r^2 + \frac{2V}{r}$.

.....

.....

.....**[3]**

A manufacturer wants to produce tins that hold 60 cm^3 of liquid with a minimum surface area.

(ii) Use calculus to determine the values of r and h that will give a minimum surface area.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....**[6]**

6 **(a)** A die is biased so that when it is thrown the probability of it showing a 2 is 0.15.

Find the probability that when the die is thrown twice that the side numbered 2 will be shown at least once.

.....

.....**[2]**

(b) A sample of screws taken from a production line have masses, to the nearest tenth of a gram, as shown in the frequency table below.

Mass (g)	3.0	3.1	3.2	3.3	3.4	3.5
Frequency	7	13	9	4	3	2

(i) Find the mean and standard deviation of this sample.

Mean = ……

Standard deviation = ……
[5]

(ii) State if the distribution of this sample has a negative skew, a positive skew or is approximately symmetrical.

.....**[1]**

END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional answer space is required, you should use the following lined pages. The question number(s) must be clearly shown – for example 1(c) or 6(b).

OCR
Oxford Cambridge and RSA